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ALASKA'S FISHERY RESOURCES

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Alaska's Fishery Resources
The Pink Salmon

By
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ABSTRACT

Pink salmon, *Oncorhynchus gorbuscha,* also called humpback salmon, are the most abundant of the Pacific salmon in Alaska. Alaska production of pink salmon has an average wholesale value of $28 million and constitutes more than half of the total North American catch. Female pink salmon carry about 2,000 eggs each and spawn in late summer or early fall. The resulting fry emerge the following spring and migrate directly to salt water. They spend 1 year at sea and return as 2-year-olds to spawn and die in their native stream. Alaskan pink salmon usually spawn only a short distance from the sea; many even spawn in intertidal streambeds. Fewer than 25 percent of the young survive from the time of spawning until the time of emergence from the gravel. Similar low survival rates prevail during the estuarine and oceanic portions of the life cycle. Pink salmon are just over 1 inch long when they enter the sea, but they grow to an average length of about 20 inches and weigh about 4 pounds as adults. Research biologists of several agencies assist fishery managers by determining the migration paths and the factors that affect abundance of pink salmon.

ALASKA'S FISHERY RESOURCES – THE PINK SALMON

By

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INTRODUCTION

Pink salmon, *Oncorhynchus gorbuscha*, are called the bread and butter fish of the Alaskan salmon industry because they are the most consistently abundant of the five Pacific salmons in Alaska—pink, sockeye, chinook, coho, and chum. The name "pink" comes from the delicate color of the flesh of the pink salmon, which is also known as "humpy" or "humpback" salmon because of the hump that develops on the back of the spawning male (fig. 1).

DESCRIPTION

As with all salmon, the pink salmon change their external color as they mature. In the late spring just after the fry emerge from the streambed, they have a general silvery appearance and their backs are often deep blue to green. They are easy to distinguish from other salmon fry because they do not have the dark bars or spots, called parr marks, that are prominent on the sides of other salmon fry, such as the chum salmon, which are found most frequently with pink salmon fry (fig. 2). During the first 3 months after they enter the ocean, all young Pacific salmon are silvery and have a similar general appearance, but experts can recognize pink salmon by their small and numerous scales and by subtle differences in shape and color and in internal structures. In about August of their first year in the sea, juvenile pink salmon develop on their backs and tails the large dark spots that are characteristic of the adults.

At the end of their second summer in the ocean when pink salmon begin their migration back to fresh water, they have further changes in color and body shape. The silvery sheen is replaced by dark sides and a white belly, and the dark spots on the back and tail become more prominent. At this time the males develop their pronounced hump, as well as an elongated hooked jaw with large sharp teeth.

GEOGRAPHIC DISTRIBUTION AND ABUNDANCE

Pink salmon occur in streams from California to the Arctic Ocean on the North American side of the Pacific Ocean and from the Arctic Ocean south to Hokkaido Island of northern Japan on the Asian side. Their oceanic distribution extends from North America to Asia north of the 40th parallel through the Bering Strait into the Arctic Ocean.

Although several attempts have been made to transplant pink salmon to waters outside their natural range, no new important fishery has been established. The United States planted them in rivers in Maine, the Russians in tributaries of the Barents and White Seas of northern Europe, and the Canadians in tributaries to Hudson Bay and in rivers in the Maritime Provinces of eastern Canada. None of these efforts resulted in runs that survived more than a few cycles.

Although pink salmon do not usually complete their life cycle in fresh water, an accidental release of several hundred fry resulted in a population that perpetuated itself for a few cycles in Lake Superior.

The geographic distribution tells us nothing of the importance of a fish—it is the abundance that determines its value to the fishermen, and the best available measure of the abundance of pink salmon is the commercial catch. The catch in Asia is about twice that in North America. Puget Sound is the southern limit and Bristol Bay the northern limit of commercially important runs in North America. Alaska produces more than half of the North American total, and southeastern Alaska produces about half of Alaska's total catch. Other important pink salmon-producing areas in Alaska are Prince William Sound, Cook Inlet, Kodiak Island, and the south side of the Alaska Peninsula.

NATURAL HISTORY

The life of the pink salmon begins in late summer or early fall when the fertilized eggs are deposited in the gravel and start to develop. These eggs hatch in midwinter; the fry emerge from the streambed in the spring and migrate directly to sea. There they spend 14 or 15 months feeding and growing before they return to their home stream to spawn and die. The life cycle of the pink salmon is illustrated in figure 3, and some of the biological characteristics of this species are compared with those of the other Pacific salmon in table 1.

Pink salmon have the shortest and simplest life history of any Pacific salmon. Because they have a 2-year life cycle and return to their native streams to spawn, two genetically distinct lines occur in each stream. The lines are called "even-" or "odd-year" on the basis of the year in which the adults spawn. Differences in the number and in the size of the fish in the two lines have been the subject of speculation for many years. In some areas, only one line spawns in significant numbers, leaving fisherman with few or no fish in an "off" year. For example,

Figure 1.–Mature pink salmon–male (upper), female (lower).

in southern British Columbia and Puget Sound, runs large enough for profitable commercial fishing occur only in odd years. Conversely, in western Alaska since 1954, the even-year runs have been the larger. Fortunately the major pink salmon-producing areas of Alaska do not suffer from this type of off-year scarcity.

Spawning

Pink salmon usually ascend streams only short distances to spawn, although in British Columbia and California some migrate more than 200 miles from the sea to the spawning grounds, and in Asia they migrate up to 400 miles from the sea. In Alaska, pink salmon typically spawn in the lower reaches of short coastal streams, although many use the intertidal areas of these streams, where the eggs are alternately bathed by fresh and brackish water as the tides ebb and flow (fig. 4). In Prince William Sound, for instance, between 50 and 75 percent of the pink salmon fry are produced in intertidal zones.

Spawning usually begins in August or September when stream temperatures are about 50° F. Water temperatures near freezing are common in winter. The spawning season and the time of fry emergence are related to the temperature regimes of the streams. Pink salmon tend to spawn earlier in colder streams and later in warmer ones. The eggs hatch from 3 to 5 months after they are spawned, but the fry remain in the gravel until April or May.

To prepare the spawning nests, the females dig pockets, called redds, in riffles with gravel bottoms. The redds are from 4 to 10 inches deep, depending on the size of the female and the velocity of the water current. After she has dug her redd, the female releases her eggs a few at a time and the male releases a cloud of milt containing sperm which fertilize the eggs as they fall to the bottom of the redd. Egg laying is alternated with more digging at the upstream face of the redd so that each release or cluster of eggs is quickly covered with sand and gravel,

Figure 2.–Pink and chum salmon fry that have just emerged from the streambed. The pink salmon are distinguished by their smaller size and the lack of the parr marks that are noticeable on the backs of the chum salmon fry. In these live fish the fins are nearly transparent because they are very thin and unpigmented.

and a new egg pocket is formed to receive the next cluster. Sand and gravel protect the eggs from sunlight, floods and predators, and the female protects them from being dug up by other females who are digging their own redds.

Pink salmon are somewhat inefficient at burying their eggs in the streambed; some of this inefficiency can be traced directly to the density of the spawners. When too many females are present, some frequently dig up eggs that are deposited by other females, and some may not be able to deposit all of their eggs before they die.

Males and females both die soon after they spawn.

Survival

A mature female pink salmon usually has about 2,000 eggs, but if only two of these survive to return as mature spawners the population will be perpetuated. The life history of pink salmon occurs in three physically and biologically distinct environments–streams, estuaries, and the ocean–and biologists have studied survival in each environment. In the stream less than 25 percent of the eggs survive from the time of spawning to the time of emergence from the gravel. The principal causes of the death of salmon eggs are (1) digging in the redds by other females, (2) low oxygen supply because of low streamflows or impairment of water circulation within the streambed, (3) dislodgment of eggs by floods, (4) freezing of eggs during periods of severe and prolonged cold, and (5) predation by other fish. Less is known about survival in the other two environments, but indications are that about three-fourths of the fry entering the estuary are lost before they reach the ocean and that of those reaching the ocean, about three-fourths die before they attain maturity. Predation is believed to be the principal cause of death in the estuary and at sea.

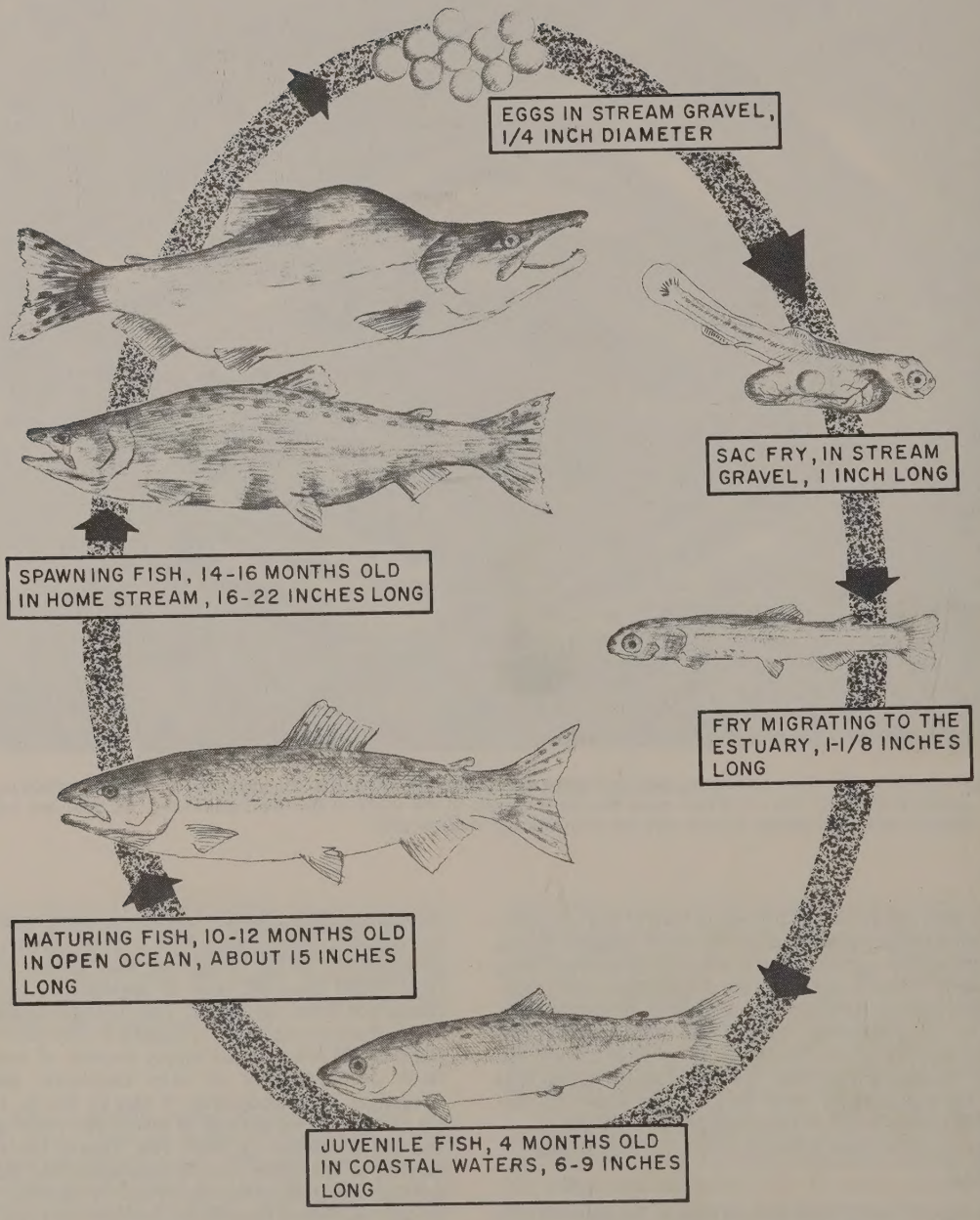
EGGS IN STREAM GRAVEL, 1/4 INCH DIAMETER
SAC FRY, IN STREAM GRAVEL, 1 INCH LONG
FRY MIGRATING TO THE ESTUARY, 1-1/8 INCHES LONG
JUVENILE FISH, 4 MONTHS OLD IN COASTAL WATERS, 6-9 INCHES LONG
MATURING FISH, 10-12 MONTHS OLD IN OPEN OCEAN, ABOUT 15 INCHES LONG
SPAWNING FISH, 14-16 MONTHS OLD IN HOME STREAM, 16-22 INCHES LONG

Figure 3.–Life cycle of pink salmon.

Table 1.–General life history features of the five species of Pacific salmon in Alaska (Exceptions to these general descriptions occur frequently)

Species of salmon	Fresh-water habitat	Time spent in fresh water after emergence from gravel	Time spent at sea	Year of life at spawning	Average weight of adults[1]	Average eggs per female
			Years		Pounds	Thousands
Pink	Short streams	Usually less than 1 day	1	2	4	2.0
Chum	Short and long streams	Less than 1 month	2–4	3–5	8	3.0
Sockeye	Short streams and lakes	12-36 months	1–4	3–6	6	3.5
Coho	Short streams and lakes	12-24 months	1–3	3–4	9	3.5
Chinook	Large rivers	3–12 months	1–4	3–6	20	4.0

[1]Weight of whole or round fish. Source: Int. North Pac. Fish. Comm., Bull. 12, p. 48.

Food and Growth

Pink salmon fry grow slowly while they are buried in the streambed and are just over 1 inch long when they migrate to sea. While in the streambed, they obtain nourishment from the yolk of the egg, which contains a balanced "diet" of protein, carbohydrates, vitamins, and minerals. Growth increases rapidly after the fish reach the sea and its abundant supply of plankton. Pink salmon select their food by sight and swallow it whole. As they grow larger, they feed on progressively larger animals, until squid and other fish are included in their diet. In the extensive estuaries of southeastern Alaska, they may reach a length of 6 to 9 inches before they move into the open ocean. When they return to fresh water several months later, their usual average length is about 20 inches, and their average weight is about 4 pounds. Mature pink salmon do not feed in fresh water.

Migrations

Pink salmon fry emerge from the gravel at night and begin their migration to the sea. When the distance to the sea is short, they reach the estuary of the stream before dawn. In the first few days in the estuary they form schools near the surface of the water and migrate along shore. At this stage they move with surface currents and are carried out of the estuary into the ocean in a few days to several weeks.

It is not known how salmon are able to find their way from the estuary to the ocean feeding grounds and to return to their home stream. According to one theory, they continue to move more or less passively with the prevailing surface currents, which carry them in a roughly circular path out into the North Pacific Ocean and back toward their home stream. Most biologists believe that as the fish approach the coast again, a keen sense of smell and a good memory enable them to find their home stream by its characteristic odors. This theory does not explain, however, how those American and Asian salmon stocks that intermingle at sea are able to find their way back to their home continents.

ECONOMIC IMPORTANCE

Salmon fishing is the largest commodity industry in Alaska, and pink salmon is the most valuable species (table 2).

Most pink salmon are caught in coastal waters by purse seiners (fig. 5), but a small percentage of the commercial catch is taken by gill nets. Commercial trollers and sport fishermen catch a few pink salmon while fishing for chinook and coho salmon. The fish are generally canned in shore-based plants and then shipped to Seattle, Washington, for distribution to world markets. By-products of salmon canning have gained commercial importance in Alaska in the past few years. The eggs of all species are processed into caviar and fish bait and the heads and viscera, which were formerly discarded, are now frequently processed into pet food. The annual value for these products has been several million dollars.

Figure 4.—Pink salmon spawning in the intertidal zone of a creek.

In addition to the commercial uses for pink salmon, Indians and Eskimos along the Arctic coasts take thousands of them in traps and gill nets for personal use.

RESEARCH AND MANAGEMENT

The pink salmon is an important source of high-quality protein and is also a renewable resource—one that can be maintained for future generations if properly used and conserved. The Alaska Department of Fish and Game is responsible for this use and conservation.

The foremost aim of the State agency is to get the proper number of spawners into the streams to maintain a high level of production. Management includes regulation and enforcement of fishing seasons, areas, and gear. The salmon fishing regulations, which are set during the winter before the fishing season, are based on knowledge of spawning escapements, abundance of young salmon migrating seaward, and estimates of ocean mortality.

Research biologists of several agencies assist the fishery managers by determining the effects of different numbers of parent spawners on the number of young produced, the factors that cause mortalities of eggs and fry in the gravel, and the migration paths and mortalities in the estuaries. The 2-year life cycle of pink salmon permits relatively quick answers to studies of their fate at sea and quick response to management. The Bureau of Commercial Fisheries has several research stations in Alaska where biologists study factors that affect pink salmon production in fresh water, in intertidal areas, and along estuarine and coastal migration routes. The headquarters for these investigations is the Bureau of Commercial Fisheries Biological Laboratory at Auke Bay near Juneau in southeastern Alaska. The United States Forest Service and the Alaska Department of Fish and Game are studying the effects of logging on pink salmon production. All of these research groups are working on the development of techniques for improving and extending spawning grounds for pink salmon.

Table 2.–Numbers of fish, weight, numbers of 48-pound cases, and wholesale value of canned pink salmon caught in Alaska, 1957–66. (Not including subsistence catches)

Year	Salmon caught[1]	Pounds[2]	Standard cases[3]	Wholesale value of canned products[4]
	Millions	Millions	Thousands	Millions
1957	--	54	714	$16.6
1958	--	121	1,548	32.1
1959	--	48	635	15.0
1960	--	53	731	16.8
1961	22	104	1,266	34.5
1962	44	143	1,893	44.6
1963	34	125	1,570	34.0
1964	45	162	1,928	29.0
1965	20	75	932	22.3
1966	40	177	2,042	55.1
Average	34	106	1,233	$28.0

[1]Source: for 1961-65–Alaska Dep. Fish Game, Statist. Leafl. 11, Table 10; for 1966–Unpublished data, Bureau of Commercial Fisheries Statistical Office.
[2]Weight of whole or round fish. Source: Alaska Dep. Fish Game, Statist. Leafl. 11, Table 21.
[3]A standard case contains 48 1-pound cans.
[4]Pacific Fisherman 1967 Yearbook, page 110.

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Figure 5.–Hauling in the net on a pink salmon purse seiner. When set for fishing, the net encloses an area of about 2 acres.

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